

Using Social Network Analysis to Understand Spontaneous Volunteerism after a Disaster



WPI

A Major Qualifying Project

Submitted to:

The Faculty of Worcester Polytechnic Institute

in Partial Fulfillment of
the Bachelor of Science Degree

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Date Submitted: 05 April 2024

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Abstract

The 2022 full scale invasion of Ukraine provides an opportunity to learn how spontaneous volunteers act when disaster strikes. The first few weeks following the invasion, millions of Ukrainians were displaced and relied on information exchanges in online groups for housing, employment, and aid. This MQP used data collected from the Telegram platform. By utilizing Social Network Analysis (SNA) we analyzed how these spontaneous volunteers coordinated how non-governmental organizations (NGOs) can leverage these networks. Furthermore, under the guise of offering help bad actors such as human traffickers, prey on vulnerable people. NGOs can also learn about trafficking recruitment approaches happening online in and develop initiatives to mitigate recruitment.

Executive Summary

When Russia invaded Ukraine in February of 2022, it sparked the largest humanitarian crisis Europe since World War II. Established aid organizations were not ready to provide large-scale aid and were also slow to react. Therefore, the first to respond to the crisis were spontaneous volunteers, who started to organize themselves in online groups in offering aid to those that needed it. These online groups had users requesting and offering help such as housing, transportation, and employment for those affected. Through these online groups, support networks were formed in which needed aid could be provided to those needing it. While the majority of help from volunteers are well meaning, a small number of individuals preyed on the vulnerability of displaced Ukrainians and signs of possible recruitment for human trafficking and exploitation could be found. Recognizing that these aid organizations could learn from these networks, we employed Social Network Analysis to analyze these groups. Using collected data from scraped Telegram groups, messages from one such group was analyzed to provide recommendations to NGOs.

By determining the monthly and overall top users, we concluded that most messages were well meaning and likely not coming from traffickers. We also determined that top users were also not top users during the first two months of the group's existence, which were the most active.

While more time is needed to fully understand what is happening in these groups, we concluded that the information contained in them is still of paramount importance to aid NGOs as they can use it to understand what the needs are and how to best distribute their aid. Furthermore, anti-trafficking NGOs can also benefit from joining these groups so they can post information and tips on how to avoid falling victim to trafficking.

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1 Introduction

1.1 Understanding Refugees and Volunteer Response

The United Nations defines a refugee as “someone who has been forced to flee his or her country because of persecution, war, or violence. (UNHCR, 2017).” But why do these people flee their countries? Most of the time, individuals flee their country due to war, tribal and religious violence, and political revolutions, to name the major causes. Furthermore, the United Nations reports that “52% of the world’s refugees come from Syria, Ukraine, and Afghanistan (UNHCR, 2017).” In the United States since 1975, there have been over 3 million refugees resettled in all 50 states (UNHCR, 2020). As defined by the United Nations basic needs approach, when these refugees flee their country or even become internally displaced they require “health, nutrition, WASH (water sanitation, and hygiene), shelter, energy and domestic items (UNHCR, 2018).” With refugees being displaced for an average of 10-26 years, some longer-term needs are the integration of these individuals into the local community, and locating jobs so that there is a steady source of income so that they are not on the edge of poverty (Ferris, 2018). In an era of mass media, society at large may not be aware of the stories of these people, their journeys, and their experiences. Globally, the refugees invoke a mixed volume of reactions, discussed in the following studies conducted by the Pew Research Center (Lipka 2022). In Western countries, the public is split on whether immigrants add to the strength of the country. In the United States, 34% of those polled in a recent study believe immigrants are a burden and 59% believe that they are not (Lipka, 2022). Some residents in countries with refugees associate them with an increase in crime and terrorism; within Europe, 59% of individuals believe that refugees increase the risk of terrorism with 36% believing that they do not (Poushter, 2016). While there are individuals who are not

inclined to support refugees, there are volunteers who rise to the occasion when a disaster occurs and are the first ones to help. This volunteer effort plays a big role until established aid organizations such as the UN, the Red Cross/Crescent can enter.

During times of disaster, volunteers are often some of the first people to respond to the situation. For example, during the COVID pandemic, volunteers stepped up to help in hospitals when they were over. A study in the United Kingdom states that during the pandemic 12.4 million individuals volunteered to help in these situations (Together, 2021). In Ukraine, during the opening weeks of the war, volunteers were key to the humanitarian effort during the beginning weeks of the war. Due to this volunteer effort, a large humanitarian catastrophe was circumvented (Dunn and Kaliszewska, 2023, para. 4). Another example of this is the recent Israel-Hamas war. After the outbreak of the attacks, thousands of grassroots volunteer initiatives have appeared across the country to help those in need (Kershner, 2023). Some of these efforts include distributing clothes and medicine, bulk-producing meals, collecting resources (chargers and clothes) for soldiers, and providing psychological support for victims (Kershner, 2023). While this volunteer effort is heartwarming, where are the established aid organizations?

Established aid organizations like the UN, Red Cross/Crescent, and Doctors Without Borders provide more large-scale humanitarian aid efforts. During times of war, like the conflicts in Ukraine and Gaza, the violent nature of the conflicts makes it difficult for these established aid organizations to operate (ICRC, 2022). In Ukraine, large-scale, formalized aid was unable to be delivered to internally displaced people until humanitarian corridors could be established several months after the beginning of the full-scale invasion (Amnesty International, 2022). Currently, as the bloody Israel-Hamas conflict unfolds, the people of Gaza, due to the Israeli blockade, are facing dwindling resources such as water, food, and medical supplies. Furthermore, the infrastructure of

Gaza is on the verge of collapse with minimal electricity, and according to medical teams in Gaza, the “medical system is on the verge of collapse. (Ebrahim and Haq, 2023)” Due to this urgent need for aid, humanitarian groups are calling on both parties in this conflict to establish concrete humanitarian corridors for aid to be delivered (Ebrahim and Haq, 2023).

In recent conflicts and disasters, volunteer support is crucial in providing urgent aid until these large, established aid or humanitarian organizations arrive. One of the causes of the delayed involvement of aid organizations is the lack of urgency from parties involved in the conflict to create these humanitarian corridors which help provide large amounts of aid to impacted populations.

1.2 Ukrainian Context

In February of 2022, Russia significantly escalated its conflict with Ukraine, which was first invaded in the Eastern part of the country in 2014. This escalation was a full-scale invasion of the country (Figure 1). Since then, fighting has occurred in various locations throughout in the country. These include but are not limited to Kharkiv, Mariupol, and Kyiv, which are major cities in Ukraine. Many properties have been damaged. Significantly damaged infrastructure includes the Kakhovka Dam, which caused mass flooding in the city of Kherson (Wilson Center). Tens of thousands of people have died, hundreds of thousands injured and millions been displaced, both internally (to somewhere else in Ukraine) and externally (to other countries). As of February 2024, those who are displaced internally in Ukraine number 3.7 million (UNHCR), while those who are refugees (externally displaced) number 6.5 million. In total, about a quarter of the country's 43 million people are displaced.



Figure 1: Initial Russian Invasion of Ukraine, March 1, 2022 (voanews)

Internally, Ukrainians were trying to flee the frontlines of the Russian advance. Externally, Ukrainians were trying to escape the country to avoid war and move far away from the conflict. However, with this surge in refugee activity at Medyka, one of the busiest border crossings, there was no response from the United Nations High Commission for Refugees (Dunn and Kaliszewska, 2023). For example, when Dunn and Kaliszewska (2023) visited multiple border crossings in Poland, they saw that large aid organizations and central governments were absent from providing aid to displaced individuals. They go on to claim that “humanitarian catastrophe” was avoided due to the significant volunteer response that they saw at the border (Dunn and Kaliszewska, 2023, para. 6). Other sources such as Amnesty International (2022), and New York Times (2023) discuss the border crisis and how the first-hand volunteer response in Ukraine is much more effective than that of large, centralized aid organizations.

1.3 Human Trafficking

Under the guise of the conflict, another crisis emerges. Human traffickers, whether it be for sex, labor or other purposes, benefit from the invasion to further their goals. When people are forcibly displaced due to conflict, they often have little time to plan where they go. Moreover, they lose their support networks, employment opportunities and housing. This leaves them particularly vulnerable to certain offers of aid, since they will usually take whatever they can get. Traffickers will therefore exploit this vulnerability by promising refugees and those displaced with jobs, a place to stay, food, and other items that are essential to survival to lure those that are vulnerable into their schemes.

1.4 Use of Online Platforms to Connect Volunteers and Refugees

In today's age, many interactions happen online, thus coordinating a volunteer response to a disaster is no different. In the opening days of the invasion, many displaced people formed online groups seeking information. Similarly, many people wanted to help those displaced. Connections between displaced people and these spontaneous volunteers happened in online groups to better coordinate the response and understand the needs of those affected. Platforms used to create these groups include but are not limited to, WhatsApp, Telegram and Discord. Discussions in these groups have a wide variety of topics, such as informing displaced people of troop movements, offering housing and employment to those that need it, and even advice on how to leave the country, among other topics. Since many people had to move on a short notice out of their homes, they have urgency to find a new place to live and to work, which puts them in a vulnerable position to be trafficked or exploited. Such vulnerabilities, especially when an individual is posting in online, public spaces, makes them a target for human traffickers.

1.5 Problem Statement

With so much exchange of information on these online groups, established NGOs need to understand how they work for (1) to aid humanitarian aid distribution, and (2) to prevent bad actors from benefitting from well-intentioned and/or vulnerable people. Spontaneous volunteers sometimes have more knowledge into what kind of aid is needed most and where, as well as an understanding of local cultures and norms. This is because these volunteers are typically locals in the disaster region. This project seeks to better understand what happens within these groups to help inform NGOs responding to disaster situations. Thus, the problem this MQP is addressing is: How can information exchanges in online groups formed in response to a humanitarian disaster be used to inform humanitarian aid efforts?

1.6 The Team

This Major Qualifying Project is part of a larger project being worked on by students supervised by Professor Renata Konrad at Worcester Polytechnic Institute. The group further consists of Amir Jamali (PhD student in WPI's School of Business), Solomiya Sorokotyaha (masters student in WPI's School of Business) Leonardo Coelho (author of this paper, undergraduate student) and formerly Atharva Tiwari (undergraduate student, who contributed in part to this project). The team has met at least once a week since September 2023, except during end of year break at WPI. Additionally, Professor Laura Dean from Millikin University was also a part of the team and provided contextual expertise and domain knowledge. Professor Dean is the director of Human Trafficking Lab at Millikin University.

2 Literature Review

2.1 Spontaneous Volunteers

Typically, when a disaster happens, spontaneous volunteers show up en masse to help immediately after the event in question. Meanwhile, established aid organizations take their time to usually get set up and organized to help those in need. This has been seen many times in the past, including but not limited to: the 2004 Indian Ocean Tsunami and the 2015 Nepal Earthquake (Daddoust et al, 2021). The majority of initial rescue operations were done with spontaneous volunteers. While these responses are necessary and effective, they can sometimes be a challenge when the number of volunteers is very high and there are few or no leaders to coordinate them. Traditional aid organizations tend to avoid working with spontaneous volunteers because they can be a liability. Untrained personnel, lack of leadership and dynamic conversation, and the sheer number of volunteers that can show up in a large disaster can get in the way of trained personnel arriving (Daddoust et al, 2021).

Daddoust et al (2021) conducted a questionnaire to help understand why Ontario Emergency Responders were unwilling to let spontaneous volunteers help. They found that jobs that require at least a certain amount of skill can be a liability if the volunteer is not properly trained. Liabilities include but are not limited to injury of volunteers and breaching legislation. The paper concludes that while spontaneous volunteers can be utilized with success, and have many desirable knowledge such as awareness of local community norms, they are still a liability to aid providers.

More information about spontaneous volunteers can be found at: Carlsen et al (2022) and Ye et al (2023). Both these sources are listed in the references.

2.2 Social Network Analysis

When spontaneous volunteers organize, they enlist people that aid them. These groups create what is called a social network. A social network is a group of people connected by their relationships to each other. Today's social networks are often formed in social media and online interaction. While different social media can be used to create and maintain social networks, the project analyzed Telegram groups as the place where social networks were formed. Telegram is an online messaging app which users can either directly message each other or create groups where messages are shared to a list of individuals.

To analyze social networks, Social Network Analysis is often used. Social Network Analysis, like the name implies, investigates the connections of social groups to understand how a given social network was formed and operates¹. Understanding how spontaneous refugees and human trafficker's social networks operates could be key in understanding how to learn from, and how to help spontaneous volunteers or identify signs of human trafficking.

In social network analysis each person, or actor, is a vertex, or node, on the graph. The connection between the actors is called edges. When a node has many connections, or degrees, it is said to have a high centrality. When two nodes are closely connected to one another (when they have few intermediate nodes that connect them), they are said to have a high closeness. Lastly, if a node is often used in the shortest connection between other nodes, that node is said to have a high betweenness.

¹ <https://us.sagepub.com/en-us/nam/social-network-analysis/book258181>

More information on Social Network Analysis can be found at: Alvarez et al (2013), Ye et al (2023), Carlsen et al (2022). All these studies are listed at the references. They make a strong case of why Social Network Analysis can be used to understand the problem at hand.

3 Methodology

3.1 Objectives

To understand how spontaneous volunteers and human traffickers work and better inform NGOs how to combat them, the following objectives were accomplished:

1. Understand the situation happening currently in Ukraine.
2. Sort and analyze message data and online users using Social Network Analysis of scraped Telegram groups.
3. Develop recommendations for NGOs.

3.2 Objective 1 Understand the situation happening currently in Ukraine.

To obtain a comprehensive understanding of the invasion of Ukraine, several approaches were used. The first approach is a standard Literature Review and web browsing. Reading articles, reports, and research papers about the situation and how people and nations responded to it helped understand what is happening in Ukraine. Once we developed a sense of understanding the context, we spoke to experts in the field of human trafficking in Eastern Europe. Professor Laura Dean of Millikin University is a specialist in human trafficking and added context to many messages, emojis, as well as help understanding the Ukrainian language. Furthermore, Dr Dean traveled to Ukraine in early March where she interviewed 10 anti-trafficking NGOs that are able to better explain the situation.

3.3 Objective 2 Sort and analyze message data and online users using Social Network Analysis of scraped Telegram groups.

For the data analysis, we used scraped data by Amir Jamali, a PhD student working under Professor Konrad. Amir scraped data from various Telegram groups that were created in February 2022 when Russian invaded Ukraine and displaced people began communicating in newly formed chat groups to seek advice as they were fleeing affected sites. The groups that were scraped include but are not limited to “Moldovaukraina” and “refugeesinPoland”. Amir’s project as a PhD student is much larger in scope than what is covered in this paper, so only data from the Telegram Group “Moldovaukraina” was used, though the process can be adapted and repeated for the other groups which were scraped.

This analysis has several steps which were done concurrently, partly by the author and partly by Professor Konrad’s research group. The research group focused on translating the scraped data from Ukrainian, Russian, and other languages into English for easier analysis. The research group also manually labeled messages and users according to two categories: (1) suspicious or non-suspicious, and (2) asking for help or offering help. This analysis will be combined with the author’s analysis (see Section 4) to provide a bigger picture of what is happening in the Telegram groups.

The author started by first contacting WPI’s Social Media Analytics Lab² which is headed by Professor Hall-Phillips. A PhD student working in this lab, Aameer, helped this project by using the data to construct a discrete graph of the Telegram groups. The author granted Aameer access to the data and talked him through what the data meant and the context behind the data. User ids were the nodes of the network, and message replies were connections or edges.

² <https://www.profahp.com/smal>

However, the graph proved too cumbersome to analyze directly because of its size. Thus Cytoscape³ a computer software, was used to filter the nodes by the number of connections. By filtering by users by those who had a 750 or more replies, the seventeen most active users were determined.

The author then developed a python script (Appendix A) to sort through all messages and identify the top seventeen users (Figure 2). A bar graph of monthly activity of, by users was also created in the same script (Figure 3 is an example).

1001024539
651384595
420340544
5308958106
5361242673
395276312
314557900
518746763
5301976713
1109465675
767394706
283366610
2035898482
803556581
481015297
6124698220
5347619995

Figure 2: Overall top 17 users, listed by User ID

³ <https://cytoscape.org>

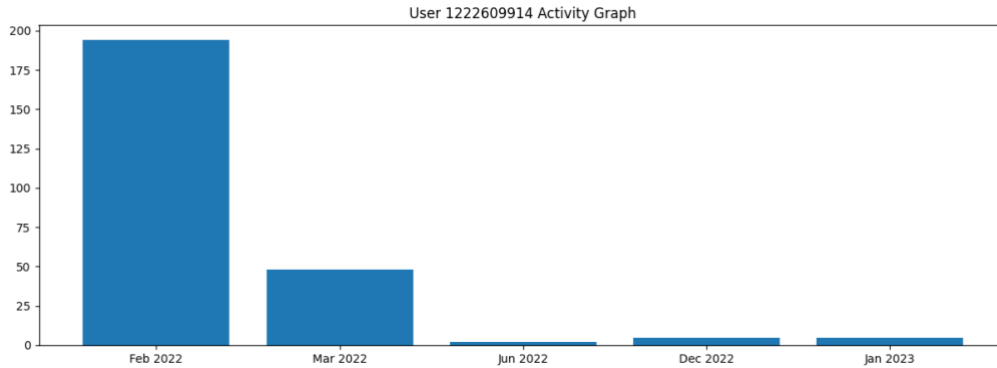


Figure 3: User 1222609914 Activity Pattern. This is just one of many users.

The next step was to determine the seventeen most active users for each month the group was active and for which we had data. WPI’s SMAL lab was again contacted, and a graph was produced for each of the 18 months that the group had existed for since the messages were scraped. To further the analysis, the top seventeen users were analyzed by month. This analysis was done in Excel using the COUNTIF function (Figure 4).

User	Feb-22	Mar-22	Apr-22	May-22	Jun-22	Jul-22	Aug-22	Sep-22	Oct-22	Nov-22	Dec-22	Jan-23	Feb-23	Mar-23	Apr-23	May-23	Jun-23	Jul-23
1001024539	0	0	0	0	0	0	1	1	0	1	1	1	1	1	0	1	1	1
651384595	0	0	0	0	0	0	0	1	1	1	1	1	0	0	0	0	0	0
420340544	0	0	1	1	1	1	1	1	1	1	0	1	1	1	0	0	0	0
5308958106	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1
5361242673	0	0	0	1	1	1	1	1	1	1	1	1	0	1	0	0	0	0
395276312	0	0	0	0	0	0	1	1	1	1	0	1	1	1	1	1	1	0
314557900	0	0	0	0	1	1	0	1	0	1	1	1	1	1	1	1	1	1
518746763	0	0	0	0	1	1	1	1	0	0	0	0	0	0	0	0	0	0
5301976713	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
1109465675	0	0	0	0	0	0	0	1	0	0	0	0	0	1	1	1	1	1
767394706	0	0	0	1	0	0	0	0	0	0	0	0	1	0	1	1	0	0
283366610	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1
2035898482	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
803556581	0	0	0	0	0	0	1	1	1	0	1	0	0	0	0	1	0	1
481015297	0	0	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0
6124698220	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	0
5347619995	0	0	0	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0

Figure 4: Table indicating the overall top users who were also monthly top users.

3.4 Develop recommendations for NGOs.

Once messages were sorted and analyzed, the next step was to understand what they were trying to convey and develop recommendations for NGOs on what this type of analysis can be used for, both for the current situation in Ukraine as well as any future disasters which can invoke a similar response. Furthermore, as this is an Industrial Engineering MQP project, understanding what the field of Industrial Engineering as can learn from this type of analysis is important.

4 Results and Analysis

4.1 Overall Group Activity

The scraped Telegram spans the time period from group creation in February 2022, up to and including July 2023.

To further understand user activity, the Social Media Analytics Lab was contacted to make a graph for each month that we had data for. We then repeated the process of filtering the nodes until we had identified 17 top users for each given month. Unlike the top 17 overall users, the reverse process was followed. We determined how many replies and replied-to a user had to have to be considered a top 17 user. This was done to have a consistent number of users across all months, and also because not every month a user had 750 or more connections. In fact, this was only true the first two months of the group's existence, as activity decreased significantly after March 2022.

Once we had a list of overall top users, and monthly top users, we investigated to see if any of the overall top users were also a monthly top user, and if so, for which months. Indeed, many of the overall top users were also a top monthly user, but surprisingly, none of the top overall users were top users in the first two months of the group's existence, which were the two most active months, as measured by number of messages sent.

Another analysis we did was to create a Python script (Appendix A) to extract messages and create a bar graph of the user's activity by number of messages sent each month. While most users' activity dropped off after March 2022, many of our top users exhibited activity patterns that did not coincide with the events of the invasion (Figure 5).

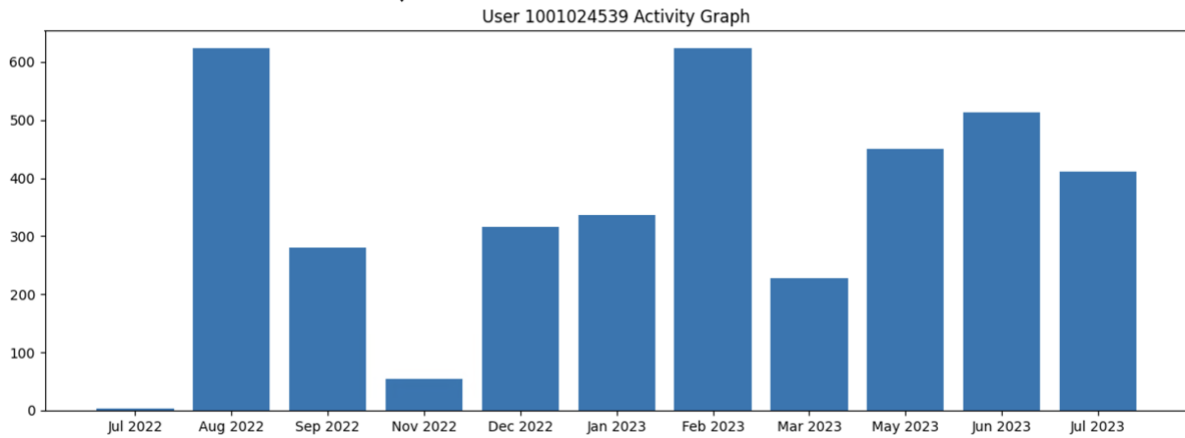


Figure 5: User 1001024539 Activity Pattern. This user’s activity does not correspond to major events in the invasion.

The drop in activity after March 2022 for most of the users can be explained by the arrival of established aid organizations into the area. It is also possible that many displaced people were able to find help after the first two months and therefore didn’t need to be active in the group anymore.

The author also requested PhD student Amir to look into the classification of top users, both overall and monthly were classified as. After accounting for duplicate users, there were 151 top users in total. Looking at how these messages were classified as provided mixed results. First, only nine of the 151 users were sending messages classified as suspicious of human trafficking. This reinforces that most users in the group are well meaning.

Next, when looking at if the users were offering help or asking for help, only forty-two of 151 users had messages that made the intention clear. We were unable to classify the rest. Finally, a few users were simultaneously listed as being vulnerable to trafficking and as suspicious of being a trafficker (Figure 6). We are unsure of why this is, but it does reinforce that the model to analyze messages needs to be refined.

Suspicion of Human Trafficking: Yes
Types of Trafficking Likelihood: Sex
Trafficking - 0, Child Trafficking - 1, Labor Trafficking - 2, Forced Marriage - 0, Other Types - 2
Nature of the Message: Offering help
Individual's Potential Role: 1-Trafficker
Specific Need Targeted: Travel and Adventure
Level of Vulnerability to Human Trafficking: 2-High vulnerability

Figure 6: One user's classification.

5 Conclusion

5.1 Information for NGOs in Humanitarian Situations

Overall, more analysis is needed to fully understand what is happening in these online groups. However, we note that these groups provide a fundamental platform for spontaneous volunteers to coordinate help and those affected by the crisis to request help. As such, we provide two recommendations for NGOs. First, we recommend NGOs make use of the types of groups, join them, and work with an analyst their content to better understand the types of needs people have and try to identify key actors responding. NGOs could potentially coordinate with these actors to disseminate information about services NGOs are able to provide.

We also recommend NGOs post directly in such groups so they can post accurate and reliable information. For example, anti-human trafficking NGOs can provide warning regarding fraudulent employment or housing opportunities to minimize the chances a vulnerable person falls prey to a trafficker.

5.2 Industrial Engineering Opportunities

Responding to a humanitarian crisis is challenging, particularly if a responder has little or no training on how to do so, such as a civilian volunteer. Understanding their role and how these spontaneous volunteers respond to a crisis, even if it was poorly done, can provide key insights into management techniques that can be applied elsewhere or avoided entirely.

Furthermore, how can Industrial Engineering techniques, like simulation and optimization, can be used to improve the situation? The simplest way to answer this question is by looking at supply and demand. When refugees or displaced people arrive at a town, the quantity supplied of labor and the quantity demanded of housing may increase significantly, with its corresponding

opposite often lagging behind. For example, as increase in quantity demanded of various supermarket goods may lead to shortages of said goods, such as food or cleaning supplies.

Using simulation techniques, it could be possible to build models to determine at which point the current supplies will last when refugees start arriving. This information is crucial for suppliers as it can be the difference between full shelves in a supermarket, or shortages for everyone, refugees, and natives alike. Inventory management techniques can also help manage shortages.

Another issue that needs to be considered is where to send the refugees. When refugees enter border towns en masse, they might often consider going further from the violence they were fleeing in order to find a higher paying job or more security. It is crucial to send these refugees to a place where they will quickly adapt, find a job as well as a place to stay, which are the main factors in assuring they will remain safe. Successfully optimizing refugee placement under the constraints of how many additional people a certain town can hold without shortages of goods or homelessness can drastically increase refugee quality of life in their new homes.

Additionally, when an NGO has to decide how much aid and presence must be sent to each refugee hotspot, it is critical to minimize wasted supplies. Equivalently, an anti-human trafficking NGO must also be able to determine where to focus its efforts on breaking human trafficking.

All of the situations described above require data on where the refugees and human traffickers are going to. Some of this data may be in the Telegram groups. Spontaneous volunteers and those displaced often indicate where they are and where they are going to, which in turn can be the source of data for simulation and optimization models.

5.3 Future Work

For the next steps of this project, the most important step is to refine translations and classification models for the messages and users. Having a classification algorithm that accurately classifies messages will help better understand signs of trafficking and who a legit user is without any conflicting information. Furthermore, for future crisis, the analysis can be done in the local language of the crisis to avoid having to translate messages and having results being skewed because of the differences between languages. However, since the vast majority of Artificial Intelligence models are tuned for English, a crisis that happens in an English speaking local should be the foremost focus of this research as it will provide the clearest results.

Also of importance is allowing spontaneous volunteers to help established aid organizations. It was previously discussed that these organizations tend to avoid working with spontaneous volunteers because of the risks that it brings, such as legal risks. Understanding how spontaneous volunteers work best can help inform aid organizations how to best utilize them without fear.

Finally, a deeper understanding of how human traffickers find victims also need to be understood. Informing those vulnerable of how to avoid being victim of trafficking by analyzing the most common recruitment techniques. It is also important to stress that criminals constantly adapt with the goal of staying ahead of law enforcement, so common monitoring for traffickers is essential to providing adequate protection to those in need.

6 Reflection

6.1 Design

In this project we designed a tool to extract messages based on the user id and graph when those messages were sent. We then analyzed these messages to understand what these users were saying and to determine if they were likely traffickers or highly vulnerable. The tool was built in python and iterated over time as new features were requested. The first version of it did not include the graph, only the message extraction. It stopped being improved when the python knowledge of the writer was exhausted, and it was no longer feasible to keep improving it as it would require time to learn more python.

6.2 Constraints

This project involved extensive handling of sensitive data. The data is also de-identified. However, these constraints did not limit what could be done with this project as its goals were more so understanding what was happening in these groups, and this is not constrained by the limitations we had. The most limiting part of the project was done by graduate students, which involve translating the messages, and since Ukrainian and English are very different languages, these translations were often unclear, which hampered our understanding of what was actually being said.

6.3 New Knowledge

This project required acquiring knowledge of the situation in Ukraine and the importance of it. This was done by talking to experts and reading literature. Overall, while the author did make an early push to use more classwork concepts in this project, there was no time in the end for it. This hurt the project significantly, as the author prefers working with exactly what was learned in the classroom.

6.4 Teamwork

This project started as a duo but ended as a solo. For reasons unknown, Atharva left the team midway through the project without warning. This severely hurt the project as it was already behind, and the author was left to pick up the pieces and make something work. Furthermore, the topic of the project left a lot of ambiguity, and the author works better when he is in a situation with little ambiguity, where he can apply the concepts directly as learned from the classroom. These factors severely hurt the project and contributed to the final quality of the work.

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Appendices

Appendix A: Python Script

```
import pandas as pd

import calendar

import matplotlib.pyplot as plt

def getMessages(x):

    t={}

    data=pd.read_csv(r"\\research.wpi.edu\BUS\rkonrad_telegram\Translated Files\Telegram
Group - -moldovaukraina\Translated (cleaned)\Cleaned level 4 - corrected user
id\All_English_and_merged_file_corrected_ids.csv', usecols=["from_id", "message", "date"])

    for i in range(len(data)):

        a=data.iloc[i,2]

        a=a.strip("")

        data.iloc[i,2]=a

    data["from_id"]=pd.to_numeric(data["from_id"])

    final=data[data.iloc[:,2]==x]

    final=final.sort_values(by='date')

    for j in range(len(final)):

        b=final.iloc[j,0]

        c=b[0:4]

        d=int(b[5:7])

        d=calendar.month_abbr[d]

        e=d + ' ' + c

    try:
```

```
t[e]
except:
    t[e]=1
else:
    f=t[e]
    f=f+1
    t[e]=f

final.to_csv(path_or_buf=r"\\research.wpi.edu\BUS\rkonrad_telegram\Analysis\Leo
Scripts\user_" +str(x)+ "_messages.csv",index=False)

plt.rcParams["figure.figsize"]=(15,5)
plt.bar(range(len(t)), list(t.values()), tick_label=list(t.keys()))
plt.title("User " +str(x)+ " Activity Graph")

plt.savefig(fname=r"\\research.wpi.edu\BUS\rkonrad_telegram\Analysis\Leo
Scripts\user_" +str(x)+ "_activity_graph.png")
```